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Diversity of Phytoplankton and Pollution Tolerant Species of Navule Pond, Shivamogga, Karnataka

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Abstract

The present study deals with phytoplankton population of Navule pond in Shivamogga during September 2014 to August 2015. Blue-greens constituted the major group (41.75%) followed by Chlorococcalas (36.68%), Diatoms (13.36%), euglenoids (7.35%) and Desmids (0.86%). The phytoplankton community was composed of 11 species of Blue-greens, 20 species of Chlorococcales, 18 species of Diatoms, 11 species of Euglenoids and 08 species of Desmids. Each group of phytoplankton showed different peak periods, the summer season produces relatively more phytoplankton than rainy and winter season. The variations in physico-chemical parameters are responsible for the fluctuation of quantity of phytoplankton. The dominant genera recorded on the pond were *Anabaenopsis* sp., *Ocillatoria* sp., *Euglena* sp., and *Phacus*. Some of the pollution tolerant species identified during the present

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study are *Scenedesmusquadricauda*, *Coelastrum* sp., *Tetraedonmuticum*, *Ocillatoria* sp., *Phormidium* sp., *Microcystis* sp., *Anabaena* sp., *Navicula* sp., *Synedra ulna*, *Cyclotella* sp., and *Pinnularia* sp. In the present study *Microcystisaeroginosa* was recorded indicates the civic pollution.

Keywords: Phytoplankton, Navule Pond, Pollution tolerant speices, Microcystis, Shivamogga

1. Introduction

Navule is an annual water body as it receives water from rainfall. Various physic-chemical and biological factors determine the quality of water. Physico-chemical parameters play a vital role in determining the distribution pattern and quantitative abundance of organisms inhabiting particular aquatic ecosystems.

Phytoplankton is the major primary producers in many aquatic systems and is important food source for other organisms [1]. Phytoplankton not only serves as food for aquatic animals, but also plays an important role in maintaining the biological balance and quality of water [1]. Phytoplanktons are defined as free floating unicellular, filamentous and colonial organisms that grow photo-autrophically in aquatic environments. They are the basic food chains and food webs which directly provide food for zooplankton, fishes and some aquatic animals [2].

Plankton abundance and diversity are widely used as biological indicators of still water quality in lakes and reservoirs. They are sensitive to watershed conditions and exhibit sufficient stability in assemblage structure over time to take them useful as long-term monitors of lake health and indicators of water quality. Phytoplankton studies and monitoring are useful for control of the physico-chemical and biological conditions of the water in any water body. Therefore certain groups of phytoplankton, especially Blue green algae, can degrade recreational value of surface water, particularly thick surface scum, which reduces the use of amenities for contact sports, or large concentrations, which cause deoxygenation of the water leading to fish death [3]. Over the last few decades, there has been much interest in the processes influencing the development of phytoplankton communities, primarily in relation to physico-chemical factors [4], [5].

Due to certain reasons some plank tonic population flair-up to dominate water body and ultimately blooms form. Unlike other algae, all the common bloom forming blue-green algae contain gas vacuoles, which can impart positive buoyancy to the algae under certain conditions. Some species of blue-green algae aggregate and make a colony floating over the surface forming the bloom. Generally bloom occurs in the ponds where sewage or organic nutrients supply is maximum. These water blooms have got tremendous effect in the fishery. Water bloom besides imparting color to the water also gives a disagreeable smell and taste to it. It is reported that some of these algal bloom forming species liberate a toxic substance due to their metabolism and these substances are dangerous so far as fisheries are concerned [6].

2. Study area and Methodology

Navule pond is situated 6 kms away from Shimoga city. It lies between 14° 22' N latitude and 75° 50' E longitude. Total water spread area of this water body is 15 hectares. Rainfall is the major source of water. The water body is mainly used for growing agricultural crops. Similarly the anthropogenic activities like cattle washing and washing of vehicles are observed.

For qualitative and quantitative analyses of phytoplankton one liter of composite water samples at surface level were collected at an interval of 30 days. One liter of sample was fixed with 20ml of 1% Lugol's Iodine solution and kept 24 hours for sedimentation. 100 ml of sample is subjected to centrifugation at 1500 rpm for 20 minutes and used for further investigation. Identification of plankton up to species level was done by referring standard manuals [7-9]. Quantitative estimation of phytoplankton was done by counting cells.

3. Results and Discussion

Table 1 depicts the Monthly occurrence of different groups of phytoplankton density and Phytoplankton taxa recorded in Table 2. Fig. 1 shows seasonal changes of phytoplankton density and Fig. 2 shows distribution of phytoplankton percentage (%). Monthly accurence of physico-chemical parameters are depicted in Figs. 1-12. Phytoplakton taxa is depicted in Fig. 13.

3.1 Water Temperature

The water temperature is influenced by factors such as altitude, season and depth of water. Values of temperature ranged from 21-28^{0}C, minimum value recorded in December and maximum in April.

3.2 pH

pH is the measurement of hydrogen ion concentration. The value ranges from 8.1 to 8.9. The minimum value was recorded in October and maximum in January. The pH is an important parameter in a water body since aquatic organisms are well adapted to specific pH and do not withstand abrupt changes in it [11].

3.3 Turbidity

The value ranges from 34 to 158 NTU. Minimum recorded in September 2014 and maximum 2015.

3.4 Disolved oxygen

Disolved oxygen is an important gaseous factor that determines the quality of water and in turn regulates the distribution of aquatic organisms. In the present study the DO level fluctuated between 5.4-10.6mg/l. The highest and lowest values were recorded in July and September months. The variations of DO depend on the primary production and respiration of aquatic organisms.

3.5 Biological oxygen demand

BOD is the measure of degradable organic matter present in water. The BOD and other microbial activities are generally increased by the introduction of sewage [12]. The values ranged from 2.8-7.3mg/l. The highest and lowest values were recorded in August and April. The highest value was found above permissible limit of 6.5mg/l as per WHO (1991).

3.6 Total dissolved oxygen

TDS ranged from 183mg/l (September) to 296mg/l (July). The values are within permissible limits of 1500mg/l (BIS, 1992).

3.7 Total hardness

Total hardness is not a pollution parameter but indicates water quality mainly in terms ca+ and Mg+ contents. TH values observed are 104mg/l (September) and 197mg/l (April) is not suitable for domestic use in drinking.

3.8 Nitrate

The nitrate values ranged between 12.4 to 27.1mg/l. The highest and lowest values were recorded in September and March respectively. The increase of nitrate is associated with water runoff and sewage discharge.

68 phytoplankton were recorded among which Chlorococcalean group were dominant next to blue-greens and comprising 36.68% of the total phytoplankton population. Seasonal variation of Chlorococcalean group reached their maximum during summer season. Tripathi and Pandey [13] are of the opinion that high temperature favours the abundance of chlorococcales. A total of 11 genera and 20 species of Chlorococcales were recorded in this pond of which *Actinastrum* sp, *Coelastrum* sp, *Pediastrum simplex*, *Scenedesmus quadricauda* appeared in all the months and *Pediastrumsimplex*, *Chlamydomonas* sp, *Eudorina*sp. and *Chlorella* sp. appeared as rare forms. The genus *Scenedesmus* was represented by 7 species, *Pediastrum* by 3 species *Crucigenia* by 2 species and other forms like *Actinastrum*, *Ankistrodesmus*, *Chlorella*, *Coelastrum*, *Chlamydomonas*, *Eudorina*, *Selenastrum*, *Tetradron* were represented

by single species. Abundance range from minimum 11,867 org/l in the month of october 2015 to maximum of 18,267 org/l in the month of May 2015. Seasonal variation reached their maximum during summer season. Some of the pollution tolerant species [14] identified are *Scenedesmus quadricauda*, *Coelastrum* and *Tetraedon sp*.

Comparatively desmids population recorded less which represents 3 genera and 8 species and constituting of 0.86% of total phytoplankton population. The diversity of desmids was considered a genus *Cosmarium* represented by 6 species, *Staurastrum* and *Micrasterias* were represented by single species. The population density reached their peak in the month of May 2015 with 26 org/l while in the month of September 2014 recorded least number with 11 org/l. Venkateswarlu [15], Biswas [16] and Harikirshan *et al.* [17] emphasized the importance of bright sunshine and temperature in the regulation of desmids population showed that desmids have positive correlation with temperature. If the pattern of distribution of desmids is considered they were found to be more during summer months. Some pollution tolerant desmids [14] recorded from the study area are *Cosmarium* sp, and *Staurastrum* sp. The density of these species was found to be more in Hadadilake which indicate eutrophic nature of water body.

The ecology of Diatoms has been studied by several researchers like Philipose [18], Zafar [19], Pandey and Pandey [20]. In Navule pond recorded 10 genera and 18 species of diatoms constituting 13.36%) of total phytoplankton population. The diversity of diatoms considered, the genus *Navicula* represented by 7 species, *Gyrosigma* by 3 species and other forms like, *Achanthes*, *Anamoenieis*, *Cymbella*, *Cyclotella*, *Fragillaria*, *Melosira* and *Pinnularia* were represented by single species. Density of diatoms recorded maximum of 7244 org/l in the month of May 2015 and a minimum of 4844 org/l during the month of December 2015. Seasonal variation of diatoms population showed maximum density during summer months. Some of the pollution tolerant diatoms [14] are recorded from the study area, they are *Navicula* sp. *Cyclotella* sp., *Cymbella* sp., and *Pinnularia* sp., whose density was found to be high in Navule pond.

When monthly variations of euglenoids are considered, Navule pond recorded a minimum of 2,533 org/l during the month of July 2015 and maximum of 3,822 org/l during May 2015. Some of the pollution tolerant Euglenoid [14] recorded from the study area are *Euglena* sp, *Phacus*sp, and *Trachelomonas*sp. whose density was found to be high in Navule pond which indicate presence of organic matter in the water bodies.

Navule pond supported 10 genera and 11 species of blue-greens constituting41.75% of the total plankton population. With regard to their diversity the genus *Anabaena* represented by two species, the genus *Agmenellum, Aphanocapsa, Chroococcus Merismopedia, Microcystis*, *Anacystis*, *Nostoc*, *Oscillatoria*, and *Phormidium* were represented by single species**.**

Monthly density of blue-greens recorded minimum of 12,755org/l during December 2014 and maximum of 20,178 org/l during May 2015. Seasonally summer recorded more number of blue-greens. Some of the pollution tolerant blue-greens as per Palmer [14] were recorded from the study area such as *Oscillatoria* sp, *Phormidium* sp., *Microcystis* sp. and *Anabaena* sp. *Microcystis*sp. is used as the best indicator of pollution and associated with highest degree of civic pollution.

The correlation coefficient factors of different physico-chemical parameters of Navule pond explains that BOD, Turbidity and TDS is positively correlated with chlorococcales. Turbidity is positively correlated with blue green algae, chlorococcales and Desmids. In this air temperature, DO, pH, and water temperature will not show any correlations.

Harikrishnan et al., [17] recorded that high pH values promote the abundant growth of Blue-greens and they observed positive correlation with each other. The present work revealed that high pH (8.9) was recorded in Navule pond.

5. Conclusion

Blue-greens dominated with 41.75. % and Chlorococcalean group with 36.68% of total phytoplankton groups showed eutrophication. Presence of Pollution tolerating species witnessed the eutrophication of water body.

References

[1] T. Gupta and M. Dey.Hydro biological Characteristics of Some Semi-intensive fish culture ponds of Lumding town of Nagaon district, Assam. *Current World Environment.vol.* 8, 2012.

[2] M. Millman,C. Cherries and J. Ramstack. The seasonal succession of the phytoplankton community in Ada Hayden lake, North Basin, Ames, Lowa, Limnology Laboratory, Lowa State University, Ames, IA., USA. 2005.

[3] B. A. Whitton and M. Patts. The Ecology of Cyanobacteria. Kluwer Academic Publishers, Netherlands. 2000.

[4] N. Akbay, N. Anul, S. Yerti, S. Soyupak and C. Yurteri. Seasonal distribution of large phytoplankton in Keban dam reservoir. *Plank. Res. vol.* 21, pp. 771-787, 1999.

[5] J. A. Elliott, A. E. Irish and C. S. Reynolds. Predicting the spatial dominance of phytoplankton in light limited and incompletely mixed eutrophic water column using the PROTECH model. *Fresh. Bio. vol.* 47, pp. 433-440, 2002.

[6] S. P. Bairagi and M. M. Goswami. Ecology of water blooms in some ponds of N.E. India. *Environment and Ecology.vol.* 12, pp. 586-571, 1994.

[7] M. T. Philipose. Chlorococcales.Monographs on algae. ICAR Publications New Delhi. pp. 1-365, 1967.

[8] J. G. Needham and P. R. Needham. A guide to study of fresh water biology. Holden bay, San Francisco, U.S.A. 1962.

[9] T. V. Desikachary. Cyanophyta. I.C.A.R., New Delhi. 1959.

[10] F. E. Fritch. The structure and reproduction of algae. Cambridge University Press, London, *vol.* 2, 1945.

[11] J. P. George. Aquatic ecosystem: structure, degradation, strategies for management: Recent advances in ecological research, A.P.H. Publ, House, New Delhi, pp.603, 1997.

[12] H. B. N. Hynes. The Biology of Polluted water. Univ. Toranto Press, Canada. pp. 202, 1971.

[13] A. K. Tripathiand S. N. Pandey. In : Water pollution. Ashish Publishing House, pp. 1-326, 1990.

[14] C. M. Palmer.A composite rating of algae tolerating organic pollution. *J. Phycol.vol.*5: 76-82. 1969.
[15] V. Venkateswarlu. An ecological study of the algae in the river Moosi, Hyderabad (India) with special reference to water pollution I. Physico-chemical complexes. *Hydrobiologia.vol.* 33, pp. 117-143. 1969.
[16] S. Biswas, Phytoplankton periodicity in Ogelubelake, Anambra state, Nigeria. *Hydrobiologia.vol.* 246, pp.169-172, 1992.
[17] K. Harikrishnan, S. Thomas, S. Geroge, P. Murugan, S. Mundayoor and M. R. Das. A Study on the distribution and ecology of phytoplankton in the Kuttanad wetland ecosystem, Kerala, India. *Poll. Res. vol.*18, pp. 261-269, 1999.
[18] M. T. Philipose. Freshwater phytoplankton of inland fisheries. *Proc. Symp. Algal*. ICAR. New Delhi, pp. 272-291. 1959.
[19] A. R. Zafar. On the ecology of certain fresh water ponds of Hyderabad, India. III-. The Periodicity. *Hydrobiologia. vol.*30, pp. 96-112, 1967.
[20] V. C. Pandey and D. C. Pandey. Diatom flora of Allahabad (India)-1. *Proc. Indian Nat. Sci. Acad. vol.* 46, pp. 350-355, 1980.

Appendix

Months & year	Chlorococcales	Diatoms	Desmids	Euglenoids	Blue greens
Sep-14	14578	6533	11	3022	15422
Oct-14	11867	5778	17	3289	12844
Nov-14	14711	6268	14	3334	13600
Dec-14	13155	4844	18	3068	12755
Jan-05	16667	5689	21	3378	14044
Feb-15	15155	6178	19	2978	16178
Mar-15	17422	6311	20	3644	18889
Apr-15	16755	5689	24	3511	19067
May-15	18267	7244	26	3822	20178
Jun-15	12578	6533	18	2844	16667
Jul-15	13067	5733	16	2533	14311
Aug-15	14889	6267	17	3075	16622

Table 1 Monthly occurrence of phytoplankton density in Navule pond (org/l)

Chlorococcales	**Diatoms**	**Desmids**	**Euglenoids**	**Blue-greens**
Actinastrum sp.	*Anomoeoniessph aeophora*	*Cosmariumretusi formi*	*Euglena acus*	*Agmenellum*s p.
Arthrodesmus sp.	*Closterium sp.*	*Cosmariumcapit ulum*	*Euglena obtuse*	*Anacystis*sp
Chlorella vulgaris	*Cymbellacistula*	*Cosmariumconst ractum*	*Euglena spirogyra*	*Anabaena aphnizomenoid es*
Coelastrum sp.	*Cyclotellastellige ra*	*Cosmariumdepre ssum*	*Euglena gracile*	*Anabaena spiroides*
Crucigeniacrucif era	*Fragillaria sp.*	*Cosmariumnudu m*	*Euglena accutissima*	*Aphanocapsa*s p
Crucigeniaretan gularis	*Gyrosigmaaccu minatum*	*Cosmariumpunc tualatum*	*Phacus orbicularis*	*Chroococcustu rgidus*
Chlamydomonas sp.	*Gyrosigmagracil is*	*Staurastrumsp.*	*Phacus meson*	*Merismopedia glauca*
Eudorinaelegans	*Gyrosigmaelong ata*	*Micrasteriassp.*	*Phacuspleurone ctes*	*Microcystisvir idis*
Pediastrum simplex	*Melosiragranula ta*		*Strombomonasg ibberosa*	*Nostocmicrosc opium*
Pediastrumovat um	*Naviculapupula*		*Strombomonas sp.*	*Ocillatoriaten nuis*
Pediastrumconst rictum	*Navicula cuspidate*		*Trachelomonasr obasta*	*Phormidium sp.*
Scenedesmusdim orphous	*Naviculapigmea*			*Microcystisaer uginosa*
Scenedesmusobli quus	*Naviculacryptoc ephala*			
Scenedesmuspro tuberans	*Naviculamenuis culus*			
Scenedesmusplat ydiscus	*Navicularadiosa*			
Scenedesmusqua dricauda	*Naviculadicepha la*			
Scenedesmussmi thii	*Pinnulariamicro stauron*			
Scenedesmusgra cile	*Surirellacapronii*			
Selenastrumwest ii				
Tetradaedrongra cile				

Table 2 List of phytoplankton in Navule pond

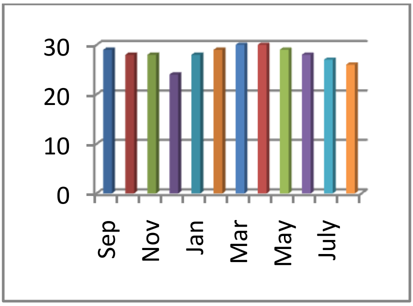

Figure 1 Monthly variations in Air temperature

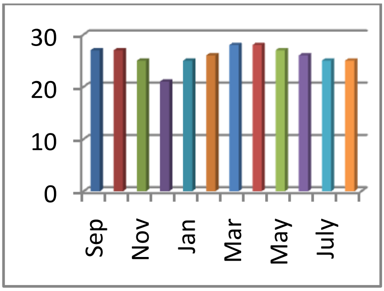

Figure 2 Monthly variations in Water temperature

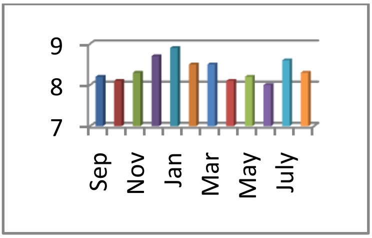

Figure 3 Monthly variations in pH

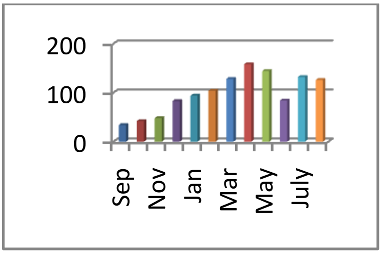

Figure 4 Monthly variations in Turbidity

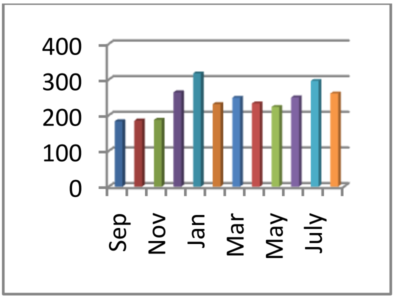

Figure 5 Monthly variations in TDS

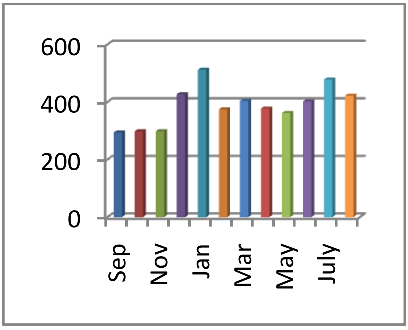

Figure 6 Monthly variations in Conductivity

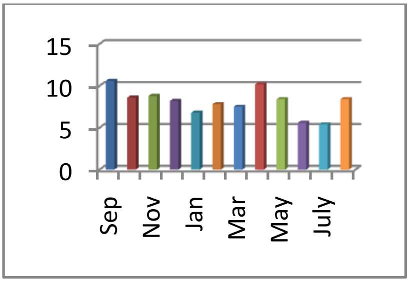

Figure 7 Monthly variations in DO

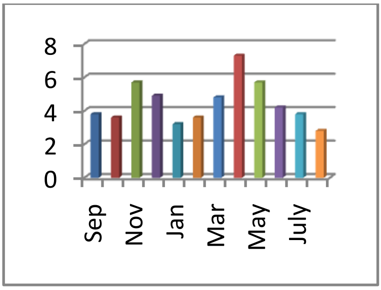

Figure 8 Monthly variations in BOD

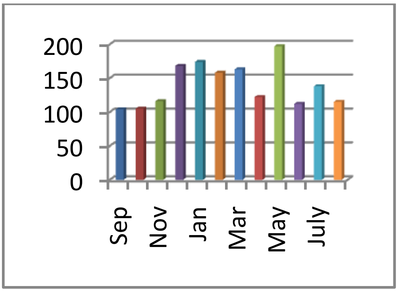

Figure 9 Monthly variations in TH

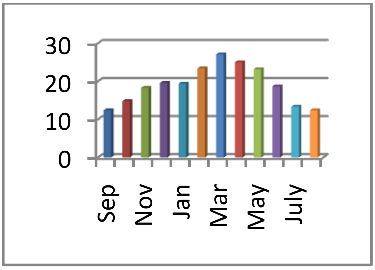

Figure 10 Monthly variations in Nitrates

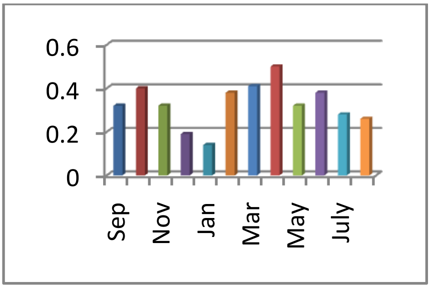

Figure 11 Monthly variations in Nitrite

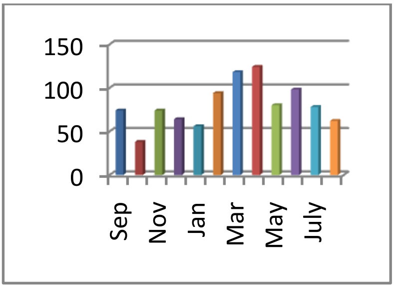

Figure 12 Monthly variations in COD

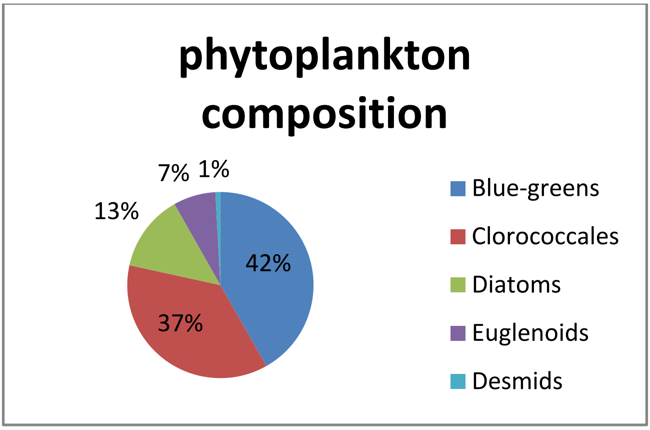

Figure 13 Phytoplankton taxa recorded in Navule pond